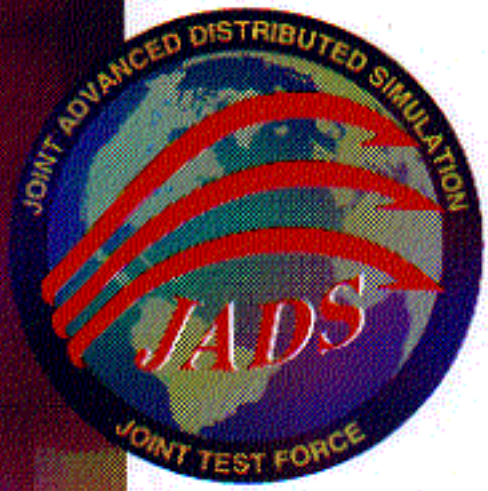
Joint Advanced Distributed Simulation
Joint Test and Evaluation

# Electronic Warfare Program Test Design 1995




NOTICE: As directed by the Senior Advisory Council, this Program Test Design documents the Electronic Warfare Test concept briefed to the Technical Advisory Board and Senior Advisory Council in 1995. Reference the Joint Advanced Distributed Simulation Analysis Plan for Assessment, dated May 1996, for the Electronic Warfare Test Chartered by the Senior Advisory Council in 1996.

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# Joint Advanced Distributed Simulation (JADS)
# Electronic Warfare (EW) Test
# Program Test Design (PTD)

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Notice: This PTD documents the EW test concept briefed to the OSD Technical Advisory Board and Senior Advisory Council in 1995. It was not chartered due to funding constraints. A revised EW Test Concept was chartered in 1996, and is documented in the JADS EW Test Analysis Plan for Assessment, dated May 1996.

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# CONTENTS

# 1. Introduction

## 1.1 PURPOSE

This document defines what actions and resources are required to accomplish a joint test and evaluation (JT&E) program of Advanced Distributed Simulation (ADS) when used for testing electronic warfare systems. This plan builds on the approved Joint Advanced Distributed Simulation (JADS) joint feasibility study and program test design (dated September 1994). The electronic warfare (EW) system test is an integral part of the original JADS joint feasibility study and scope. The requirement for this plan was specified in the JADS JT&E program charter. This plan documents the JADS EW test design of a full blown EW test using ADS briefed to the JT&E Technical Advisory Board (TAB) and Senior Advisory Council (SAC) in May and June, 1995 respectively. This test will not be implemented in this form as part of the JADS JT&E. This test design serves as a JADS legacy for future reference by EW testers and potential users of ADS. As a proposed test concept, this document does not provide descriptions of all details necessary for complete test planning since this JADS test was not chartered.

## 1.2 JT&E OVERVIEW

The JADS JT&E program is an OSD Joint-Service effort designed to determine how well an emerging technology - ADS - can support T&E activities. The following sections will explain what ADS is, how it became an item of interest to the T&E community, and what the JADS JT&E is designed to do.

### 1.2.1 DIS versus ADS - Background

The Department of Defense has used rapidly evolving information systems technology to support its needs. Early efforts were sharply focused on training applications and evolved from the Simulation Network (SIMNET) program managed by the Advanced Research Projects Agency (ARPA) and the Army. Conceptually, the project was directed toward linking training simulators with human operators, at distributed geographical sites, in a common virtual environment. The players can interact with each other in this common environment in near-real-time. Over the years SIMNET has evolved into a technology implementation which is more flexible and robust and includes different types of simulators with different levels of fidelity. Those capabilities of the SIMNET evolution are now called Distributed Interactive Simulation (DIS).

The primary function of DIS is to define an infrastructure for linking simulators of various types at multiple locations to create realistic, complex, virtual "worlds" for the simulation of highly interactive activities. This infrastructure allows users to bring together systems built for separate purposes, technologies from different eras, products from various vendors, and platforms from various Services and permits them to interoperate. The DIS infrastructure provides interface standards, communications architectures, management structures, fidelity indices, technical forums, and other elements necessary to transform heterogeneous simulations into unified seamless synthetic environments. These synthetic environments potentially support the gamut of uses, some proven, (e.g., design and prototyping, education and training), and others yet to be proven, including T&E. Institute of Electrical and Electronic Engineers (IEEE) Standard 1278 has been established to support DIS.

The principal domain for DIS is human-in-the-loop interaction with the simulation and with the synthetic environment. There are other areas of simulation, however, where DIS may not be appropriate or meet the timing or data transmission rates required. High-fidelity engineering applications, where the questions under consideration include timing and perceptual issues too fine for human perception are good examples. This limitation is often encountered in potential applications of simulation in the T&E community.

The term ADS has been developed to include network implementations which do not conform to IEEE 1278 standards, but otherwise adhere to the basic tenets of DIS as described above. The term ADS includes DIS as a subset and is intended to support a mixture of live, virtual, and constructive entities.

### 1.2.2 JADS JT&E Charter

Because of widespread interest in using ADS technology to support T&E, the Air Force Operational Test and Evaluation Center (AFOTEC) felt that a JT&E program could serve as an exploratory vehicle to examine ADS for use in the T&E community. Accordingly, the JADS JT&E program was nominated. Interest was shared by both the developmental and operational test communities. The Services concurred in the need for rigorous examination of ADS and the Office of the Secretary of Defense, Director of Test and Evaluations, chartered JADS as a full joint test program in October 1994. The Joint Test Force (JTF) was established with the Air Force as lead Service, and Army and Navy as participating Services. The Air Force provides facilities, administrative, logistics, and contract support at Kirtland AFB, New Mexico. The Services are providing a total of 37 personnel combined with an additional 13 contractors to staff the JTF.

JADS is chartered to investigate the utility of ADS for both developmental test and evaluation (DT&E) and operational test and evaluation (OT&E). JADS will investigate the present utility of ADS, including DIS, for T&E, identify the critical constraints, concerns, and methodologies

of ADS, including DIS, for T&E, identify the critical constraints, concerns, and methodologies when using ADS for T&E; and finally, identify the requirements that must be introduced in ADS systems if they are to support a more complete T&E capability in the future. Because of time and resource constraints, it was necessary for JADS to select discrete, well defined, slices of the broad T&E spectrum where data collection and analysis could be leveraged from on-going test activity. The program level concept incorporates a multiple test approach to collect data on different types of test activities. Data from the tests will be augmented with data from ADS activity external to JADS to support analytical extension of conclusions to as broad a range of applications as practical. JADS selected three test programs as vehicles for assessment of ADS utility from the broad range of C4I and weapons systems in all three services. The System Integration Test (SIT) is an engineering level evaluation of ADS using the AIM-9X and the AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM) and the End-to-End test (ETE) uses the Joint STARS system for an evaluation of ADS. In addition, JADS was tasked in the charter to "Develop an additional Program Test Design that defines the requirements, testing, evaluation, and resources necessary to incorporate EW testing into the JT&E."

After a brief overview of the two currently approved JADS tests--the SIT and an ETE, the remainder of this document will address the EW test design in detail. A complete description of the SIT and ETE tests is documented in the JADS Program Test Design (PTD), dated 12 September 1994, and JADS Program Test Plan, dated February 1996.

### 1.2.3 System Integration Test (SIT)

The SIT focuses on ADS as applied to an air-to-air missile test program. The assumption is that an ADS testing method could effectively supplement the existing techniques for testing missiles. The test will link existing AIM-120 missile live range assets with virtual/constructive facilities. The SIT configuration has both DT&E and OT&E characteristics. There is a DT&E flavor because a Hardware-in-the-Loop (HITL) facility is used to simulate the missile. This allows the detailed performance of the missile subsystems to be monitored, typical of a DT&E test. The OT&E characteristics of the SIT result from the use of live aircraft in operationally realistic engagements and man-in-the-loop interactions with the weapon system. The potential value of this ADS testing technique is not restricted to this one missile system. The intent is to extend the SIT results to a larger class of precision guided munitions.

The SIT concept involves a live launch aircraft flying against a live manned target. ADS techniques are used to link the live aircraft to an HITL simulation representing the missile. During the test, the launch aircraft engages the target aircraft and launches a simulated AIM-120. The HITL simulator then models the flyout of the missile in response to the maneuvering target and provides a measure of the miss distance between the missile and the target. Data link messages from the live launch aircraft are provided to the HITL simulator to use in its guidance algorithms during the flyout to the target aircraft. This HITL also uses the live target positional

diagnostics to monitor the performance of the missile subsystems during the engagement. This linking will be implemented with minimal latency, with near real-time being the goal.

### 1.2.4 End - To - End Test (ETE)

The ETE will evaluate the utility of ADS to complement the DT&E and OT&E of a C4I system. ADS can generate a robust test environment providing a more representative number of threats, plus the complementary suite of other C4I and weapons systems that interact with a C4I system. The Joint STARS combination of E-8C aircraft and Ground Station Modules was chosen as a representative C4I system on which to introduce ADS as a methodology in both DT&E and OT&E settings. ETE is a four-phase test. Phases 1 and 2 occur in a laboratory environment, suitable for exploring DT&E and early OT&E applications. Phase 3 checks compatibility of the ADS environment with the actual Joint STARS equipment. Phase 4 is an ADS-enhanced live open-air test replicating missions performed during the Joint STARS Multi-Service Operational T&E.

The ETE provides a complete, robust set of interfaces from sensor platform to weapon system, including additional intermediate nodes employed in a tactical engagement. Using ADS, this test will trace a thread of the complete battlefield process, from target detection to weapon assignment and target engagement. Processes will be examined at the corps level and below. The test will allow the JTF to evaluate this thread as a whole or as the contribution of any of the parts individually and to evaluate what effects an operationally realistic environment has on the system under test. The ETE seamlessly adds additional entities to the battlefield as seen by the Joint STARS sensors. In addition, the adding via ADS of some of the complementary suite of other C4I and weapons systems available to a Corps commander will enable the test team to evaluate the utility of an ADS-enhanced test environment.

### 1.2.5 Electronic Warfare Test

The tasking to complete the program test design for an ADS based test of an EW system specifically called for the use of an airborne self-protection jammer as the system under test. In the summer of 1995, JADS presented a comprehensive testing and analysis approach for an electronic warfare test to the JT&E TAB and the SAC. The JADS EW test approach was fully supported by the TAB but not chartered due primarily to the high cost ($18M). Tailoring the initial EW test design, JADS subsequently developed a reduced scope, lower cost EW test and analysis approach described in the Electronic Warfare Test Analysis Plan for Assessment (APA), dated May 1996. This test was chartered by the SAC in July 1996.

## 1.3 JT&E Focus

The emphasis of the JADS JT&E, and the EW test, is on the performance of the ADS components and their contribution to testing, rather than any particular system under test or class of weapon systems. It is important to emphasize that JADS is not evaluating any of the systems used as test vehicles. JADS is evaluating distributed test control and analysis, network performance, relationships between data latencies, and ADS induced data anomalies. Time, cost, and complexity, as well as validity and credibility of the data are part of the evaluation. Tests have been selected which will allow this comparison. Additionally, some test activities are planned that would not be feasible without ADS technology.

## 1.4 Summary

This JADS PTD describes the proposed 1995 JADS EW test concept for testing and evaluating ADS when it is used to support EW systems testing. The remainder of this plan describes the problem to be addressed in the proposed test, objectives, scope, testing concepts, and approach for solving the problem using ADS. Details describing the test methodology, the approach for addressing JADS issues, data collection, analysis, and data management are provided.